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Differentiation of human stem cells is promoted by amphiphilic pluronic block copolymers

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Abstract

Stem cell usage provides novel avenues of tissue regeneration and therapeutics across disciplines. Apart from ethical considerations, the selection and amplification of donor stem cells remain a challenge. Various biopolymers with a wide range of properties have been used extensively to deliver biomolecules such as drugs, growth factors and nucleic acids, as well as to provide biomimetic surface for cellular adhesion. Using human tooth germ stem cells with high proliferation and transformation capacity, we have investigated a range of biopolymers to assess their potential for tissue engineering. Tolerability, toxicity, and their ability to direct differentiation were evaluated. The majority of pluronics, consisting of both hydrophilic and hydrophobic poly(ethylene oxide) chains, either exerted cytotoxicity or had no significant effect on human tooth germ stem cells; whereas F68 increased the multi-potency of stem cells, and efficiently transformed them into osteogenic, chondrogenic, and adipogenic tissues. The data suggest that differentiation and maturation of stem cells can be promoted by selecting the appropriate mechanical and chemical properties of polymers. It has been shown for the first time that F68, with its unique molecular characteristics, has a great potential to increase the differentiation of cells, which may lead to the development of new tissue engineering strategies in regenerative medicine.

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Keywords

Biopolymer, Differentiation, Human tooth germ stem cell (hTGSC), Mesenchymal stem cell, Pluronic, Toxicity